

CLAIMS

THAT CLAIMED IS:

1. A centrifugal pump, comprising:
 - at least one impeller having an eye at its radial center;
 - at least one diffuser located to receive fluid exiting each impeller;
 - a first set of vanes on the impeller, each vane of the first set extending from a selected outer radius of the impeller a first length toward the eye;
 - a second set of vanes on the impeller, each vane of the second set extending from an outer circumference of the impeller a second length toward the eye, the second length being shorter than the first length; and
 - a balance hole located between each of the first set of vanes that extends through an upper side of the impeller.
2. The centrifugal pump of claim 1, wherein at least one of the vanes of the second set is positioned between each of the vanes of the first set.
3. The centrifugal pump of claim 1, wherein at least one of the vanes of the second set is equally positioned between each of the vanes of the first set.
4. The centrifugal pump of claim 1, wherein the selected outer radius is spaced radially inward from the outer circumference of the impeller.

5. The centrifugal pump of claim 1, wherein the vanes of the first and second sets are curved so that each vane has an exit angle between 50 and 90 degrees with a tangent to an outer circumference of the impeller.
6. The centrifugal pump of claim 1, wherein the vanes of the second set of vanes are curved with a concave side and a convex side, and the impeller rotates so that a leading side of the vanes of the second set of vanes is on the concave side of the vanes.
7. The centrifugal pump of claim 1, wherein the vanes of the second set have a radius of curvature that is substantially the same as a radius of curvature along a radially outward portion of the vanes of the first set of vanes.
8. The centrifugal pump of claim 1, wherein the balance holes are at least as radially inward as a leading edge of each of the vanes of the first and second sets of vanes.
9. A centrifugal pump, comprising:
 - at least one impeller;
 - an eye at the radial center of the impeller for receiving a fluid to be pumped;
 - at least one diffuser located to receive fluid exiting each impeller;
 - a first set of vanes on the impeller, each vane of the first set extending from an outer circumference of the impeller a first length toward the eye;
 - a second set of vanes on the impellers, each vane of the second set extending from the outer circumference a second length toward the eye, the second length being shorter than the first length; and

a balance hole located between each of the first set of vanes that extends through an upper side of the impeller, and at a radial position that is closer to the eye of the impeller than the outer circumference of the impeller.

10. The centrifugal pump of claim 9, wherein at least one of the vanes of the second set is positioned between each of the vanes of the first set.

11. The centrifugal pump of claim 9, wherein at least one of the vanes of the second set is equally positioned between each of the vanes of the first set.

12. The centrifugal pump of claim 9, wherein the vanes of the first and second sets are curved so that each vane has an exit angle between 50 and 90 degrees with a tangent to an outer circumference of the impeller.

13. The centrifugal pump of claim 9, wherein the vanes of the first and second sets of vanes are curved with a concave side and a convex side, and the impeller rotates so that a leading side of the vanes is on the concave side of the vanes.

14. The centrifugal pump of claim 9, wherein the vanes of the second set have a radius of curvature that is substantially the same as a radius of curvature along a radially outward portion of the vanes of the first set of vanes.

15. The centrifugal pump of claim 9, wherein the vanes of the first set of vanes are curved so that a leading side of each first set vane has an outer radial portion that is concave in shape and

an inner radial portion that is convex in shape, and the vanes of the second set are curved so that a leading side is concave in shape.

16. The centrifugal pump of claim 9, wherein the balance hole has a diameter that is between about 45 percent to about 100 percent of a length extending from a trailing surface of one of the vanes in the first set of vanes to a leading edge of an adjacent and trailing vane of the first set of vanes.

17. A centrifugal pump, comprising:

at least one impeller having an eye at its radial center;

at least one diffuser located to receive fluid exiting each impeller;

a first set of vanes on the impeller, each vane of the first set extending from an outer radius of the impeller a first length toward the eye;

a second set of vanes on the impellers, each vane of the second set extending from an outer circumference of the impeller a second length toward the eye, the second length being shorter than the first length and the outer radius having a radial position so that the outer ends of the first set of vanes is radially inward from the outer ends of the second set of vanes; and

a balance hole located between each of the first set of vanes that extends through an upper side of the impeller, and at a radial position that is closer to the eye of the impeller than the outer circumference of the impeller.

18. The centrifugal pump of claim 17, wherein the first and second sets of vanes are curved, and an outer end of the second set of vanes is curved in the same direction as an outer portion of the first set of vanes.

19. The centrifugal pump of claim 17, wherein the first and second sets of vanes are curved, and an outer end of the first second set of vanes is curved in the opposite direction from an outer portion of the first set of vanes.

20. The centrifugal pump of claim 17, wherein an outer end of the first set of vanes is farther radially outward from an inner end of the second set of vanes.

21. The centrifugal pump of claim 17, wherein at least one of the vanes of the second set is positioned between each of the vanes of the first set.